

CACTUS AND SUCCULENT JOURNAL

Of the Cactus And Succulent Society
Of America

Vol. XV

JULY, 1943

No. 7

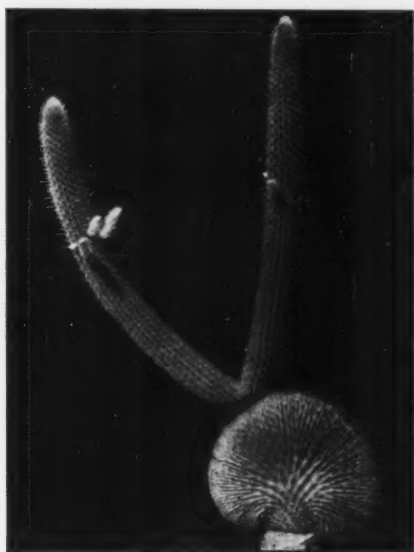


FIG. 43. Growth for Victory—you can't stop them.
Cleistocactus baumannii crest and normal form
grown by Wm. O. Bright.



CACTUS AND SUCCULENT JOURNAL

Published and Owned by the Cactus and Succulent Society of America, Inc., Box 101, Pasadena, California. A monthly magazine to promote the Society and devoted to Cacti and Succulents for the dissemination of knowledge and the recording of hitherto unpublished data in order that the culture and study of these particular plants may attain the popularity which is justly theirs. Subscription \$3.00 per year. Foreign \$3.00 per year by international money order. Membership in the Cactus Society free with subscription. Mail application to SCOTT HASELTON, Editor, Box 101, Pasadena, Calif. Editorial Staff: THE ENTIRE SOCIETY. Entered as Second Class Matter at Pasadena, Calif., under act of March 3, 1879.

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AFFILIATE NOTES

Mail your news items monthly to Mrs. Maybelle Place, 645 W. 40 Place, Los Angeles 37.

CENTRAL IOWA CACTUS AND SUCCULENT CLUB

For June there is a joint meeting and pot-luck dinner, speaker Mrs. G. Whistler, on "What Our Club Can Do for the Federation."

WASHINGTON CACTUS AND SUCCULENT SOCIETY

They have announced a "Travelog With Motion Pictures," for June, their annual election was in May and we hope soon to get the list of the new officers and hope for another of their very fine Year Books.

THE HEART OF AMERICA CACTUS CLUB

The June meeting at the home of Mrs. Carl Mutschler, Kansas City, Mo. Lecture subject, "Grafting," by Mr. Espenlaub. The winners of the plant growing contest, sponsored by Quality Hill, were First and Second Award, Mr. and Mrs. Barthel. Third prize for best single plant, Mrs. R. R. Nazer, who had to write descriptions of growing them.

HENRY SHAW CACTUS SOCIETY

At the June meeting Mr. Lorenz will show a movie of Mexico and Mr. Briner will show Kodachrome slides of his cactus collection in Florida. "Cactographs," by Ladislaus Cutak, included *Cereus validus* and *Monvillea cavendishii*. Mr. Cutak says, "*Cereus validus* or Torch Cactus has always been one of the most prolific of night bloomers in the Cactus House. Several plants are on display, but one particular specimen has branches touching the roof and regularly bears from 100 to 250 flowers a season. The flowers usually appear in May, very sparingly in June, and by the middle of July its fruits have ripened, splitting on one side and exposing the red-purple pulp inside. This Torch Cactus is at least 50 years old and is equally attractive in fruit as when in flower."

LONG BEACH CACTUS CLUB

Met at the garden of Mr. and Mrs. Rush, Los Angeles, June 27. Mr. Marshall and Mr. Haselton were among those present. Mr. Marshall gave a short talk about his garden. He has had wonderful growth on most of his plants this year and his plants have been a riot of bloom, but due to gas restrictions, fewer people see them. He brought a box of cuttings to those who cared to have them. *Lemaireocereus godingianus*, *L. humilis*, *Consolea falcata*, and *Fouquieria macdongallii*. After the picnic lunch the camera fans found many plants and flowers that seemed waiting for their attention.

NEW AFFILIATE

We are glad to welcome the Southwest Cactus Growers as an Affiliate of the Cactus and Succulent Society of America. The Club was organized in 1935 by Don B. Skinner, meeting weekly at the Manchester Playground. It was essentially a study club, and in June of that year put on its first Cactus Show, which was quite a success. The yearly show became an established feature. Each year the members seemed to specialize more and more and some outstanding collections were to be seen as a result. The Club has a very fine Library, containing most of the cactus books available and the current cactus magazines. They have taken field trips into Lower California and quite a few desert trips.

Instead of meeting weekly at the Playgrounds, they now meet once a month at the home of one of the members for the duration, and while it became necessary to discontinue the cactus shows, the enthusiasm of study and the addition of a new plant to their collections is as great as ever. The officers for the coming year are:

President	Homer Rush
Vice-President	Maybelle Place
Secretary	Lanita Olin
Treasurer	Charles Place
Directors: Walter Runyon, John Akers, Florence Cariss.	

WHAT! NO GAS!!

Well, you don't really need gas, Uncle Sam still transports thoughts through his Postal System. A little note telling of the doings of your group or what has happened in your garden, sent to this column, will be read by your many Affiliates thus contacting by the expenditure of a postage stamp as much territory as you would have covered in a year of travel.

MAYBELLE PLACE, Corresponding Secretary.

A. E. F. CACTUS FANS

Mr. and Mrs. E. Shurly, will welcome friends of the Cactus Society to their home. When on leave phone Elstree 1067 and enjoy a chat with real cactophiles. The address is "Pilatus," Deacons Hill Road, Elstree, Herts, England.

CHECK LIST

California Cactus—Baxter	1.00
Cacti—Borg	6.60

BOX 101, PASADENA, CALIFORNIA



FIG. 44. Left: *Oreocereus Doelzianus* (Haselton photo). Right: *Oreocereus celsianus* (Brassfield photo).

Oreocereus Flowers

By WM. TAYLOR MARSHALL

For a number of years the Oreocerei have occupied prominent places in the collections of California cactophiles because of the remarkable beauty of the hair-covered stems with varicolored, strong projecting spines, but they have not hertofore produced flowers here in captivity so far as I know.

This year, however, numerous plants of several species of *Oreocereus* have come into flower, the first known to me being from a plant of *O. celsianus* in the collection of Carl Brassfield. Following this first appearance of flowers more have been reported by Dr. Poindexter, R. W. Kelly and others and in my own collection *O. fossulatus* bore a number of flowers.

The flowers are similar in their somewhat zygomorphic structure, in their 4-inch length and in the extravagance of their coloration. Those of *O. fossulatus* have creamy-pink perianths and purplish pistil and stamens. *O. Celsianus* and *O. Hendrickianus* have dark red to carmine perianths but with the purplish pistils and stamens while *O. Doelzianus* has a flower with rose-purple perianths and stamens and style of the same color to accent the green stigma lobes.

Incidentally, the flowering of *Oreocereus Doelzianus* in R. W. Kelly's collection, pictured herewith, removes the last doubts as to the relationship of this species for which Backeberg erected a monotypic genus, *Morawetzia*, in the

Yearbook of the German Cactus Society, I: 10 S. 73.

In his Bulletin for Cactus Research, 8: 1936 he said, "This genus represents the highest stage of development of the *Loxanthocerei* (a subdivision in his proposed system for the red, diagonal-flowered species of *Cerei*). The flowers show the similarity of floral form as well as the plant body to other *Oreocerei*. . . . What places *Morawetzia* definitely in the section is the formation of a cephalium. Thus this genus, according to our present day conception, has attained the highest stage of development within the section. The fruit, somewhat hidden in the woolly crown, resembles externally and in internal construction that of *Oreocereus*."

The genus *Morawetzia* was erected by Backeberg on three prime points: 1. The formation of a cephalium from which flowers arise. 2. The apical position of the flowers. 3. The difference in the appearance of the seeds compared to the typical *Oreocereus*.

Kelly's plant did not produce a true cephalium at flowering time, although the hairs of the areoles were more closely massed in the nascent areoles in which the flower appeared and although the flowers certainly came from the apex of the plant, those of the other species came in new growth near the apex. Thus the first two characters on which separation is based are too slight a divergence from the flowering habit of

the other species to justify separation.

As to the third character, that of seeds differing from the typical, it is indeed hard to say what is a typical *Oreocereus* seed as Backeberg himself has said in his comments on *Oreocereus* in his Bulletin for Cactus Research, 6: 1943, "The seeds are different also. *Oreocereus fosulatus* has small, bright, black seeds; the other four on the contrary are larger, duller, brownish-black with a large hilum."

No wonder that the conservative Dr. Borg in his monograph "Cacti" placed this species as an *Oreocereus* and rejected the genus *Morawetzia*.

As I can find no description of the flower of *O. Doelziannus* in the books available to me, I append a description of the flower observed on Kelly's plant on September 10, 1942.

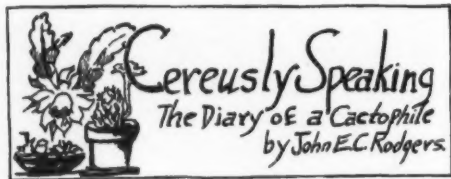
Flower tubular, slightly zygomorphic, only slightly expanded, arising from nascent areoles at apex of stem which bear also a cluster of long, white hairs; over-all length $3\frac{1}{2}$ inches, diameter less than 1 inch (2 cm.). Ovary and flower tube covered with linear scales, 2 cm. long or more, 4 mm. wide, acute, rose-purple and bearing white hairs in their axils. The outer perianth segments are similar to the scales into which they merge, and the tips are somewhat darker in color. Inner perianth segments spatulate, obtuse, entire, deep rose-purple, the midrib darker on the outside only. Filaments rose-red, as long as the perianth. Anthers light cream. Style rose-purple, robust. Stigma lobes 5, green, incurved, 1 cm. shorter than stamens.

EPIPHYLLUM BOOK ASSURED

Thanks to our good friends who have suggested a more elaborate book than we had at first anticipated, we are going ahead with a cultural handbook. A sponsor for colored plates has offered his aid and also an artist has volunteered to make drawings of the types. We will also include a list of recognized hybrids that are best known on the market today. We will try to discourage the rash naming of plants of little merit.

This book will be for and by those who are big enough to cooperate for the good of the cause and will not be prejudiced by any one dealer. Send along your notes that you think should be included in this book. Scott Haselton, Box 101, Pasadena.

Do you know that in 1592 and 1594 laws for the prevention of the falsification of cochineal were enacted, because the Indians often mixed parcels of gum, wood, maize and red earth with the powder? And further, would you believe that this fraud was considerable in comparison of that which was practised on this commodity in the ports of Spain and in the rest of Europe?



CULTURE IN OHIO

July 1. 1943 half gone and procrastination is strong upon me. I wonder if I could ever be content to let well enough alone as some cactophiles do—thrip, mealy bug, spine bug, pill bug, red spider and ants' paradise. They love non-intervention, isolation, committee checking committee, and free and equal stuff, you bet. There'll be no Pearl Harbor for my plants, no, sir,—undclared war on all fronts. Awful hot—sweated galore but I began another inspection of my plants. Must do it each month for a while, but I'm not going to run a "bug-house." Used powdered tobacco under each pot to stop drainage hole inroads by the wily ant, foxy pill bug and seven league thrip. The ants almost got away with all of my *Rebutia minuscula* seed before the berries were ripe. Wet weather evidently drove in the harvester ants. Saved enough though to raise a few plants, if I'm successful. No offsets on old plants as yet. *Malacocarpus bennisii* is one of the most prolific bloomers I have. Started early in June and has had one or two open daily. A close second is *Ceropegia stapeliiformis* (see page 58 Succulents for the Amateur), these are both "musts" for any collector.

July 3. *Harrisia eriophora* has a bud on last year's offset—white and hairy comes out near end of stem. Have been checking my cactus books for any cultural notes. Houghton lists lime for *eriophora*, *aboriginum*, *earlei* and *martinii*. *H. martinii* blooms profusely since I have given it lime and liquid manure—started spring of 1942. M. & B. have divided the *Harrisias* into *Harrisia* and *Eriocereus*; they advocate "partial shade, loose but rich soil and plentiful water in warm weather." I find a good sandy soil rich in humus with a mulch of leached cow manure, which I gradually stir into the soil, gives good results. I have an *Echinopsis* x *Harrisia* hybrid which is a vigorous grower. Has not bloomed for me. Is about three inches in diameter with one central and five to seven short black conic spines in brown wool. Has five sides for ten inches but has grown eight inches more with four sides. Resembles *E. bonplandii* more than any of the others. I also have *E. jusbertainii*.

July 4. Not much fire works—law forbids it but there's no law against spending part of my Independence Day in the Cactus House. Cleaned out the withered leaves on the *Echeverias*, *Cotyledons*, *Gasterias* and *Haworthias*. It's the winter treatment I give them that makes them lose leaves. I don't have leggy plants, either. Makes them bloom. They'd never take a prize for fine specimen plants that are well-fed and turgid, but I say, "Give beauty all her right. She's not to one form held." I want blooms on natural looking plants and I get them.

July 8. It's been too hot to work since the 4th in the Cactus House or around the outdoor plantings. Just luxuriate in the cool breezes from Lake Erie after work. No time wasted though—I study my catalogues, B. & R., M. & B., Van Laren and my other books. I can't feel I'm a self-made cactophile with the help I get from them. Surprising how a few minutes a day with my books recharges my flagging muscles and keeps the "Xerophytic" fires burning. If you visit

Lorain the latch key is always out—you can help me put my plants to bed and then visit them again as soon as I am dressed (sometimes its a bath robe and slippers, though). I find nearly all of my cactophile friends do the same. Our wives grin at us male cactophiles but if they're "Cactus Widows" it's close to home we are and they can look in on us anytime they want to. Better'n being a "golf-widow" on this score—friend wives.

July 12. *Opuntia compressa* has done the impossible this year. I planted them after the Ohio "rainy season" of April and May in a raised bed from the flats they occupied all winter "dry as a bone." I expected them to grow—yes, but not bloom. They have plenty of blooms. I checked my bloom record for the last ten years and I find they have bloomed best when I have moved them. Lewis Wahrer, Bedford, Ohio, cactophile has come to the same conclusion, "Move 'em and bloom 'em." Dr. Machwart, Parama, Ohio, moves them because of our cold, wet winters and his also bloom. We have had 53 days of sunshine since January 1st, in this section of Ohio.

July 15. So far I can't complain of being cold this year, just wet. In 1940 this date, we had an accumulated deficiency of 441° of temperature. This year we have almost 400° excess. An excess of rainfall but the ground is cracked from the steady sunshine for the past three weeks. Good thing I'm a cactophile or I'd be an awful growler.

July 18. Those "glamour groups" in my collection, the *Echinopsis*, *Rebutias* and *Lobivias*. I just can't keep my admiring glances off them. Gave them all a liberal allowance of liquid manure. Buds are developing on several which usually appear at the height of the heat wave in July and August. No shade for them where they are. Sunlight from 9:30 a. m. to 3:30 p. m. Tried having the section above them free of whitewash. When I find a group doesn't respond to one treatment, I try another. I'm a firm believer in experimentation since they're such obliging types when they do bloom (see April 6th for *Echinopsis*). By the way, all of my plants that are bedded now have few if any offsets. Perhaps I shall have the heart to discard my grafted *Echinopsis calochlora* with its 30 offsets. I have two others which are single specimens. I'm a rank amateur I know—if I were selling the offsets I'd thank my lucky stars for the prolific old *Echinopsis*. As it is I just baby them and hope.

July 23. Eye appeal well, they have it if any cacti do. My hairy columnar cacti—sturdy *Oreocerei*, *Cephalocerei*, and *Borzicacti*. Variety, harmony and adaptability make these plants collector's gems. Do all cacti bloom? Yes, when they get old enough—says I to all inquirers. Which ones don't? Those tall ones, says I. What do you keep them for then? Because I like them! About one-third of my collection must be classed as ornamental as they will not bloom or even attain "their majority" during my life time even if I were able to give them ideal growing conditions. I like them because they grow well in cramped quarters for the size of the plant, in a loose well drained soil.

July 26. *Aporocactus flagelliformis* that I mentioned June 1st was a freak. The ovary, if I can call it such, is a pinkish colored section of the stem without any stricture to show where the stem ends and the ovary begins. Spines the same as on the stem. All other flowers with ovaries dropped off, this one has not; will there be seed or is it a real freak, I wonder? I shade the pots of *Mallisoni* and *Aporocactus flagelliformis* but let the "tails" hang in the sunlight. They thrive with plenty of moisture during

their growing season and bloom in the spring, and early fall.

July 27. Found African paratroopers had landed on American soil. Heavy invasion but I was able to capture all of them before they could get rid of their parachutes. I "deparachuted" them. Yes sir, and put them in my concentration camp—*Stapelia grandiflora*, *variegata*, and *comparabilis*. I have been blitzed by dandelions through my ventilators, but "desert warfare" isn't to their liking and I just let them perish—waterless in the winter.

July 29. *Euphorbia fourneri* is now ten inches high. Its fern neighbors in a coffee can of rich muck and sand look fine and it does well, too. It was well I planted it like this for it is the only seedling from my old plant I have that has survived my other growing conditions. It's a beauty. The white vein markings on vivid green above and the red veins on a red overlay of chartreuse below are arresting to the collector of *Euphorbias* or window gardeners. *Euphorbia ledinii* has several tri-form seed capsules. Can use cuttings to increase my plants but seedlings are intriguing.

July 31. Fourth birthday of *Gymnocalycium michanovichii* seedlings. Rewarded me with blooms. Seed were from my own plant acquired from Gene Ziegler in August, 1935. Has bloomed each year early and late. I am more successful with South Americans than natives due no doubt to my assuming South Westerners need little attention. I find the South Americans do respond to greenhouse culture and the rewards are greater, too. Distance lends enchantment even in catalogues, I find. I give the natives a look but end up ordering some of the much ballyhooed South Americans from the catalogues.

Culture Cues for August, 1943

1. Work early in the morning on plants—gets hot later and my temper is none too good.
2. Water same as usual but remember some plants begin to grow and others want to rest about now—mark 'em.
3. Cut side shoots from *Pereskia* stalks to force growth into central stalk for later grafting stalk.
4. Check on fuel orders and storage space.
5. Creosote legs of benches and see that earth does not touch same.
6. Use wire brush on iron pipe supports and paint same.
7. Give *Rhipsalis* liquid manure and bone meal. (Back bone of collection for January, February and March—blooms follow *Zygocacti*.)
8. To other amateurs give generously of plants which have either become "shelf-fillers" or too plentiful due to ease of propagation.
9. Get catalogues from dealers and check plants to supply blooms in "off-places" in collection (August is one of these, I think).
10. Give special attention to the following that have bloomed in August in the past:

Cacti: *Mammillarias dolococentra*, *camptotricha* variety *senilis*; *Epiphyllums macropterum*, *anguliger*, *cartagense*, *guatemalense*, *Gymnocalycium michanovichii*; *Malacocarpus ottonis*; *Cereus bildmannianus*; *Rebutia kupperiana*; *Cleistocactus baumannii*; *Ariocarpus fissuratus*; *Astrophytum asterias*.

Succulents: *Stapelia nobilis*, *comparabilis*, *buena*, *variegata*, *grandiflora*; *Echidnopsis cereiformis*; *Mesem. roseum*, *spectabilis*; and *Lithops pseudotruncatella*.



SPINE

CHATS

LADISLAUS CUTAK



Were it not for present world conditions, we most likely would have been writing about our second national get-together, which was scheduled for Cincinnati this month. Since this event had to be cancelled, why not reminisce here about the St. Louis Convention? Didn't we all have a grand time there, back in 1941? To me it will always be one of the grandest things that could have happened. It was my good fortune that the Executive Board had chosen St. Louis for its first national conference. As soon as Bill Marshall made known the Society's plans, I immediately turned on the heat for the preparatory work that had to be attended to. Honest, I'd do it again even though it was lots of work.

Thanks certainly were due Dr. George T. Moore, director of the Missouri Botanical Garden, who made possible our meeting at that institution and for the wonderful lunch that was served there gratis to the delegates. Recall what time we had to make you break away from the feed tables? I hated to leave also but then we had important discussions planned in the historic Museum Building. Young Mace Taylor of Long Beach was everywhere with his picture box, snapping the happy crowd at the most unexpected moments. There was Mrs. Harry Osgood of Chicago hiding behind trees and suddenly appearing in front of you with a movie camera. The Naylor from Des Moines were also taking pictures for the folks back home to see. Lona Eaton Miller of the *Daily Oklahoman* was present to report convention activities for her paper and I remember the time she had garnering information from busy me. Robert W. Kelly and his charming wife endeared themselves to all of us and I know many of the delegates were proud to meet these well-known cactus growers from Temple City. Uncle Bob always tries hard to satisfy his customers. One cannot easily forget the adventurous Dr. Elzada Clover of Ann Arbor who entertained with fine movies and anecdotes of her trip down the Colorado through the Grand Canyon, the first woman to negotiate the hazardous trip. Another prominent lady was Mrs. M. H. Starkweather of Tucson, the conservation lady of Arizona, who campaigned strongly for the preservation of desert plants, particularly *Dasyllirion Wheeleri*, the common spoon lily. Who can forget W. P. Reedy of McComb, Mississippi, the gentleman who made himself heard and got action.

Recall the spirited bid Cincinnatians put in for the next Convention? It was evident that Chas. Cole and his merry gang were determined to bring it home in order not to lose face with their Chamber of Commerce. Oklahoma City, championed by Mrs. Seela and Johnson, was equally determined to hold the next confab and even offered to take the delegates on a real cactus hunt into the Arbuckle Mountains. What surprised me most was that Chicago and Milwaukee did not put in a stronger bid, for these two cities were strongly represented in the number of delegates. The Wisconsin contingent, headed by Pat White, came stag. The men left their wives behind to take care of their collections while they attended the busy sessions. The Windy City delegates showed a great deal of enthusiasm and even issued a special Convention number of their *Bulletin* which they distributed free. To me,

the Chicago members are old friends, for I have appeared at their meetings on two occasions. Chicago has always been like a second home, with friends like Bob and Betty Van Sickle, the Herman Tobusches, Mrs. Radden, Hunter, Akins and others.

One of the busiest persons turned out to be Ervin Strong, for he was the true right-hand man of Bill Marshall and he proved it. Maybe that is why he is making such a grand president of our organization. Ervin liked Missouri so much that before he left the state he was wed to his sweetheart, Dorothy Renfro, who also attended the Convention. Why the duce didn't you two get married during the Convention? All in all, I'm quite sure that those of us who were fortunate to attend the two-day confab were well pleased. Can we forget the wonderful exhibit of desert plants sponsored by the California Cactus Growers Association? Can we forget the excellent photographic exhibit of cactus prints? Can we forget the friendships of the 100 or more fellow delegates? I ask you, can you?

* * *

"New and Noteworthy Plants from Sonora, Mexico" (Contributions from The Dudley Herbarium 3: 266-284, May, 1943) brings two desert succulents to the forefront. Dr. Ira L. Wiggins and Reed C. Rollins made 15 trips into the Sonoran Desert between the years 1932 and 1941, investigating most of the major vegetational regions of the area. On the last trip a number of new plants were discovered, two of which hold interest for the cactus and succulent plant fans. A new low caespitose *Cylindropuntia*, *O. reflexispina*, was collected on the flat, sandy plain 19 miles west of Arrieros, along the road to Tastiota, Sonora. It belongs in the series *Clavatae* and seems to be related to the little known *O. bulbispina* and to *O. Grabmai*, but it differs from all other known species in the *Clavatae* series, in so far as the fruits of these species are known, in having such a heavy armament of spines on the slender fruit. The other plant, although not a new one, was up to this time imperfectly known, since Sereno Watson, its discoverer in 1891, knew only the sterile plant when he described *Agave Hartmannii*. This little century plant is similar to *A. parviflora* in general habit but with smaller flowers and fruits. It was collected on a decomposed granitic hillside on the southwest flank of the Sierra Batuc about 5 miles from Matape on the road to Batuc, Sonora.

"Two New Plants from the San Felipe Desert, Baja California, Mexico" (Contributions from The Dudley Herbarium 3: 285-288, May, 1943) introduces still another new *cylindropuntia* into the botanical world. It is *Opuntia cineracea* authored by Dr. Ira L. Wiggins. It belongs to the series *Leptocaulis* and is most closely related to *O. tesajo*, but differs strikingly from that plant in several characteristics. Dr. Wiggins claims that the higher stature and the cinereous stems of *O. cineracea* are so striking that the two plants would never be confused.

My greatest surprise in June was a complimentary copy, *List of Succulent Plants Cultivated at Kosobe Garden, Japan*, received from Moltane Megata. It had been on the road for over two years.

The Goal and Methods of Systematic Botany

By LYMAN BENSON

Exploration is the best known work of the systematic botanist or taxonomist, and indeed it is thought by many to be the only work he does. Traditionally he is an absent minded person living in a dream world and searching here and there for new species which may bear his name and perpetuate it in the science of young ladies' seminaries. Occasionally he is asked what happens if he discovers a new species—does he get a medal? What is he going to do with all the plants he collects and presses—just keep them and keep them and keep them? Is he trying to get more kinds than anyone else or is he attempting to obtain all of the kinds in Hoosis County or to find something new to the state? Even the scalp-hungry Apaches merely tapped their foreheads when they found plant collectors on their Arizona hunting grounds sixty or seventy years ago.

The real goal of systematic botany is *organization*—arrangement of the myriads of living plants into a readily understandable system made up according to their genetic or "blood" relationships. To achieve this organization the botanist must engage in the following activities: (1) *exploration* and observation in the field; (2) *classification* of what he finds and of what others have found; (3) *choice of names* for the entities he considers worthy of naming; and (4) *description* of these entities so that others may distinguish them.

I. EXPLORATION

Exploring for plants is only the beginning of systematic botany, but it is an important beginning, since it provides much of the data forming the basis for later study. For a plant specimen to be of value, it must include all of the characteristic features of possible worth in classification, and it must bear adequate data concerning the time and place of collection, the environmental situation, and the associated type of vegetation. All of these points may be significant in delimitation of species, varieties, and larger groups, and this is the scientific object of collecting specimens.

Collecting and pressing of plants, then, is not for the scientist a frantic search for new species or for rarities but the compilation of material

from which data may be secured. It provides an opportunity for comparison of plants from many places, for determining the range of variation within families, genera, species, and varieties, and for ascertaining the geographical range of each major entity and minor variant.

Exploration for data significant in plant classification is not restricted to field study and pressing of specimens to be arranged in an herbarium. Other sources of data include the following:

1. *Palaeobotany*, the study of fossil and other remnants of prehistoric plants, giving information concerning the history and development of species and their derivation from preexisting groups.

For example, in the middle Tertiary Period in the neighborhood of 40,000,000 years ago the area from the Rocky Mountains to the Pacific Ocean was essentially a plain covered to the northward by a forest of the California coast redwood type (Chaney, 1925, 1938) and to the southward by an oak woodland similar to that still existing in the central and southern Arizona mountains and in parts of New Mexico and northwestern Mexico (Axelrod, 1940). Uplift of the Cascade-Sierra Nevada axis in late Miocene and early Pliocene time resulted in increased winter cold and decreased rainfall in the interior and in consequent differentiation of various new types of vegetation in and about the newly-formed Columbia River Basin, Great Basin, and southern deserts. To the northward the Pacific Subalpine and Montane Forests evolved in the mountains of the interior, while the largely coastal Northwestern Coniferous Forest (essentially the redwood type) remained much as it was in mid-Tertiary. To the southward new elements of the Sierra Madran Flora, the derivatives of the oak woodland flora which migrated northward from the Sierra Madre of western Mexico in Tertiary time, have arisen inland, and these include the Northern Desert (sagebrush type), the Southwestern Coniferous Woodland (juniper-pinyon type), and the relatively little modified Southwestern Oak Woodland and Chaparral. Development has proceeded in another direction west of the high mountains in California, giving rise to the California Oak Woodland, the California Chaparral,

and the Pacific Prairie of the Sacramento and San Joaquin valleys. (Cf. Benson, 1942.)

Knowledge of the history of the vegetation of the states west of the Rockies is of much help in differentiating the present populations (species, varieties, and minor variants) of plants according to their relationships. For example, each of four coastal Northwestern Coniferous Forest species of *Ranunculus*, *R. occidentalis*, *R. Bongardii*, *R. orthorhynchus*, and *R. alismaefolius*, is replaced by varieties or closely related species in the Cascade-Sierra Nevada axis and in the mountains in and about the Columbia River Basin. It is not unlikely that the four species occurring in the little-modified forest along the coast are remnants of the once widespread prototypes of each of the four species complexes and that the interior mountain types are their derivatives, the better adapted new types having survived the climatic change while others died out. As another example, there are about fifteen species of oaks native in California and thirteen native in Arizona, but only two are even varieties of the same species, although the groups are closely related. Since the two geographical groups are made up of related elements in several species groups, it is likely that lack of overlapping is the result of divergent evolution in the geographical regions isolated from one another since late Miocene and early Pliocene.

2. *Genetics*, the study of heredity, revealing the basis for production of the characteristics observable in the field and in pressed specimens and the mechanism through which they are transmitted from one generation to another and through which variants arise in the field.

By experiments in breeding it is possible to determine which characters are hereditary and the types of genetic factors involved.

3. *Cytology*, the study of the cell and its contents, yielding data concerning the chromosomes of various species and varieties, from which often the relationships or origins of groups may be determined.

The following are two examples of the value of cytological data in plant taxonomy:

a. The mint genus *Galeopsis* includes well-known species with reduced chromosome numbers as follows: *G. pubescens*, 8; *G. speciosa*, 8; *G. tetrabit*, 16. In an experimental cross of *pubescens* and *speciosa*, a largely sterile triploid plant with 32 chromosomes (or 16 reduced) was yielded. Pollination with pollen from *pubescens* yielded a single viable seed, which grew into a plant with 32 chromosomes (or 16 reduced). Probably 24 of these came from the triploid female parent (reduction divisions having failed to occur), and 8 came from the pollen. This plant could not be crossed with either *pubescens*

or *speciosa*, but it crossed readily with *Galeopsis tetrabit*, and it was not distinguishable from that species on either structural or genetic grounds. The plant has been known as "artificial *tetrabit*," an ersatz species synthesized by man from other species and duplicating a Linnaean species. Experiments such as this one and many others give an insight into the methods through which species arise in nature. (Cf. Sharp, 1934.)

b. The *Rosa canina* group includes a number of closely-related roses forming populations which show no intergradation. However, they have been shown to have various chromosome numbers in the vegetative plant body (unreduced) and to have widely varying numbers in the eggs and the male gamete cells of the same individual. On the basis of the chromosome numbers (reduced) in the sex cells, sexual reproduction should be rarely possible, yet viable seeds are produced with regularity. This has been found to be due to formation of a false embryo from the tissue (nucellus) surrounding the egg. This vegetative tissue has the unreduced number of chromosomes, and the "embryo" develops without fertilization. The offspring are identical with the "female parent," just as would be cuttings taken from branches of the rose bush. This explains the stability of the characters of the various closely-related populations and their lack of intergradation. (Cf. Sharp, 1934.)

4. *Morphology*, the study of structure and development of plant organs, yielding data of value in determining the significance of structures and their homology in different plants.

5. *Physiology*, the study of the physical and chemical processes within the plant, yielding knowledge of the significance in the vegetable economy of modification of structures.

The following is an example of application of knowledge of plant physiology to taxonomy:

Flower color is sometimes useful in delimiting species and other groups, but often it is not. The members of one group of pigments, the plastid pigments, are insoluble in water, and the colors are relatively stable from living individual to individual and in dried specimens. Another group, the anthocyanins, is soluble in water, and it occurs in solution in the sap of the cells. Furthermore, these pigments are indicators of acidity or alkalinity, and in living plants they behave like litmus paper, changing toward red if the cell sap is acid and toward blue if it is basic. Almost always they change color in drying, often as a result of mixture with sap squeezed from adjacent colorless cells, and all that remains of the original color by the time an herbarium specimen is ready for study is an indication that the pigment may have been of the anthocyan group.

6. *Ecology*, the study of relationships of organisms to the environment and to one another, yielding data of great value in tracing the reasons for the past and present migrations of species and varieties and for their segregation as ecologically-adapted populations and providing knowledge of the stability of characters under differing environmental conditions.

The following is an example of means of testing the stability of characters under changing environment and therefore of determining their reliability for differentiation of taxonomic groups. A number of cuttings may be taken from the same individual plant. These genetically identical fragments are propagated in a greenhouse, and later the new plants are set out in each of several strongly dissimilar habitats perhaps long distances apart and at various altitudes. In the meantime, cuttings from plants occurring naturally in different environments and differing somewhat from one another are brought together in the same environment. These two types of tests sometimes show particular characters to be unstable with change of environment and sometimes the reverse.

No organism ever has been thoroughly known. Not even the vinegar fly, *Drosophila*, despite the endless experiments of geneticists, is completely understood, and probably it never will be. The taxonomist, drawing upon the field and herbarium for data and often obtaining additional information by experiment, determines much that is significant, but, no matter how long he may search or how many experiments he may conduct, he still has not the complete story. He must draw tentative conclusions from incomplete data or draw none at all. He is forever approaching the truth, but he never quite reaches it.

II. CLASSIFICATION

Classification of living plants and animals is not like arrangement of postage stamps, coins, or other objects created largely according to pre-arranged plans or according to more or less orderly systems. Living things have evolved in hit or miss fashion during the course of many millions of years, and their progress has not been in a simple, linear sequence such as the fancied series directly from "amoeba to man." The course of evolution has been irregular, and the many branches of development have changed directions frequently according to alteration of climate and ecological conditions in the various geological periods. Rather than being a series of simple steps from the algae to the flowering plants, the course of development within the plant kingdom may be likened to the following. Suppose that a male and a female weevil were

placed in the center of the stored wheat in a full grain elevator. Being fruitful and multiplying, these parents might give rise in time to enough weevils to infest the entire elevator. Then, by tracing the tracks of all the weevils from the beginning, one might be able to construct a diagram of about the same complexity as the one needed to represent the course of development in the plant kingdom.

The notions of fixity of species and of actual existence or clearly defined species or other categories must be discarded if one is to understand the problem of classification. The names as applied to plants and animals represent only more or less recognizable populations. Often the populations are as variable as human beings or dogs, for there may be several budding lines of evolution within them, and frequently intergradation of major populations is so nearly complete that it is difficult to tell where one begins and the other ends. Distinctions rarely are clear cut, and most species include a broad range of variants, many of them adapted to particular ecological conditions and some of them isolated in specific geographical regions during thousands or millions of years and differing much or little from the other phases of the population. Conspicuous or striking characters apparently setting off particular groups as separate entities may break down completely after study, and it is obvious that the differentiation of groups is not a matter for snap judgment.

Species and other categories are not necessarily always of the same degree of distinctness. Some are of the type that anyone may recognize and upon which all may agree—marked by an abundance of stable characters and with slight or no variation. Others are as difficult to define as the races of dogs, for the mongrels exceed the pure-breds, and many of those which are hardly to be called mongrels are off type. In these cases it may be possible to define only the extreme forms or to describe the range of characteristics within the entire group. In other cases, the plastic mass of related forms may be capable of segregation into two or more groups with some degree of distinctness and with far fewer intermediates than extremes.

Obviously the groups to be assigned scientific names must be natural. They must not be so finely subdivided that a similar system applied to human beings would call for consideration of a brown-eyed man as a different species from his blue-eyed mother or father. Persons adopting such narrow and unnatural divisions are known as "splitters." As an example, in 1905 a particular author decided that there were not six or eight species of *Eschscholtzia* but one hundred and twelve, and most of these were forms of the

California poppy, *Eschscholtzia californica*. The California poppy varies somewhat, and there are a number of minor local forms in which particular characters are predominant much as certain human genetic characters are more common in Ireland than in France although they are all to be found in both countries. Furthermore, the California poppy has a distinctive habit of its own. In the perennial forms, the stems arising in early spring are robust and they bear relatively large greenish leaves and flowers with a predominance of orange and with a relatively large torus (platform) at the base of each. As the season advances through late spring and summer, the old stems die and the new stems are progressively more slender and with smaller bluish leaves and smaller yellow flowers with the torus relatively narrower. The plants named in 1905 as different species were of no more stability and distinctness in their characters than the families of a Middle Western town might be in theirs, and many of them were merely seasonal forms of the same population. On the other hand, groups must not be so broad that they include elements not actually a part of the same genetic population. For example, lions and tigers obviously are closely related, since they have too many characters in common for their coincidence to be mere chance, but to consider them as the same species would be absurd, since they are in no sense a part of the same genetic population. Persons adopting such broad and unnatural divisions are known as "lumpers."

Within the limits of distinctly natural populations, there is still much that must be settled by individual judgment, for many species include partly segregated populations differing from one another as do the principal races of human beings and with the points of difference more or less inconsistent in their occurrence and in their tendency to be associated with one another. Ever since a short time after 1753 when Linnaeus put into effect the (binomial) system of naming plants according to genera and species, there has been difference of opinion concerning the breadth of the range of types to be included in each category. The groups recognized by Linnaeus were broad, and commonly taxonomists with a tendency to recognize broad categories have been known in the botanical vernacular as "conservatives." Those tending strongly away from the policies of Linnaeus have been dubbed "liberal" or "radical" according to degree. There has been a continuous line of conservatives, and schools of liberals and radicals have arisen at one time or another. Probably there will be always both points of view and varying degrees of intermediate opinion, since all viewpoints are tenable as long as

the classification system is natural. Mutual agreement upon a standard is not possible because of the complexity of the problem and the individuality of human beings who work together only by agreement and not by coercion.

The test of a systematic botanist's work in classification is not whether he is conservative or radical but whether he organizes well. The same bit of research may be interpreted conservatively or radically without theoretical loss of value, and the following is an example.

The *Ranunculus occidentalis-californicus-canus* complex includes the best known buttercups occurring from Alaska to California and northwestern Wyoming. Within this complex there are three major groups, each, as it happens, with a separate geographical range but each with a common frontier with both of the others. Along these frontiers, it is possible to find here and there minor local populations displaying various recombinations of the characters of the two adjacent major populations, but each of these minor groups represents only a minute percentage of the complex as a whole. Within the group commonly called *Ranunculus occidentalis* there are eleven principal geographical populations distinguished by characters less stable than those segregating the three major members of the complex; within *Ranunculus californicus* there are four; within *Ranunculus canus* there are three. To summarize, according to the opinion of the writer, in addition to scores of minor variants there are eighteen populations of sufficient distinctness and stability of associated characters to be accorded scientific names. Some might consider these to be a single species with seventeen varieties besides the typical one; others might call them three species, each with the number of varieties indicated above; still others would recognize eighteen separate species. Any of these three interpretations could be defended.

On the other hand, while any of the three interpretations might be acceptable upon theoretical grounds, there is a practical question to be considered. Which of the three interpretations is most nearly consistent with policies for classifying the entire plant kingdom prevailing in the world as a whole, as far as this can be determined? It is not desirable to have the names of plants in constant turmoil as different scientific papers and books come out, and the nearer all taxonomists can come to achieving a common policy the better, even though it is not to be expected that such an ideal as absolute unity of opinion can be attained. Therefore a system of classification of a particular group which is far out of line with the most generally adopted ones should be examined carefully to

determine whether it possesses any particular merit which warrants its retention. Ultimately it should be a contribution toward a consistent system of classification of the entire plant kingdom or it should be rejected. For example, in 1902 a German botanist proposed that all of the plants in the mustard family should be considered as a single genus *Crucifera* instead of as many genera. This required endless recombinations of names creating an arrangement wholly unfamiliar to anyone. Adopting it would require not only renaming the plants of the mustard family, but, for the sake of consistency, of all other families. As another example, from about 1906 to 1929 another author published an arrangement recognizing twenty-eight genera to represent the group commonly known as a single genus *Astragalus* (loco weeds). This required hundreds of new combinations of names, and, for the sake of consistency of policy it should have required hundreds of thousands more for bringing the treatment of the other genera of the plant kingdom into harmony with the treatment of *Astragalus*.

III. CHOICE OF NAMES

Once a satisfactory scheme of classification has been formulated, it is necessary to apply scientific names to the recognized entities. This is not as simple as it may seem, for there are many more scientific names than plants. For example, the 4,000 odd species of grasses have received perhaps 10,000 or 20,000 names during the course of the last two centuries. These have been applied by workers in various part of the world, and often they have been ignorant of one another's work, unaware that the populations being named were mere phases of previously known groups, or in disagreement about classification or rules of nomenclature. One foxtail millet, *Setaria geniculata*, has been named twenty-two times, and the epithets have been used in seventy-four combinations as species or varieties of seven genera. Obviously such confusion and difference of opinion coupled with the vastness of the task of naming the 200,000 or 300,000 members of the plant kingdom creates a problem in need of settlement according to rules.

The original publication of the system of naming by genera and species (Linnaeus, 1753, 1754) constituted a complete review of the relatively small number of plants known at the time, and no rules for naming others seemed necessary. Botanical works multiplied, and by the middle of the Nineteenth Century confusion reached such a degree that an International Botanical Congress met at Paris in 1867 to formulate rules (Anonymous, 1867) to guide taxo-

nomists in choice of scientific names. This body adopted the Paris Code, which set forth simple and apparently obvious principles essentially as follows together with many detailed regulations:

1. One plant may not have more than one name.
2. No two plants may have the same name.
3. If more than one name has been applied to a plant, the valid name shall be the earlier one, but priority begins with 1753, since the binomial system was used only inconsistently by Rivenus and a few others before Linnaeus.
4. The author's name shall be cited with each scientific name in order that confusion may be avoided in case of duplication of names, e.g. *Yucca macrocarpa* Engelm (in 1881) and *Yucca macrocarpa* (Torr.) Coville (in 1893), the names being applied to different plants.

The present universally accepted International Rules of Botanical Nomenclature (Rendle, 1934; Briquet, 1935) are a complete and rather complicated guide for the systematic botanist to follow in application of names. The primary objectives of the rules are as follows:

1. Fixity of names.
 2. Rejection of "forms [of names] and names which may cause error or throw science into confusion."
 3. Avoidance of "useless creation of names."
- "Other considerations, such as absolute grammatical correctness, regularity or euphony of names, more or less prevailing custom, regard for persons, etc., notwithstanding their undeniable importance are relatively accessory."

In order that jealousy may be avoided and that the rules may be universally acceptable, the scientific names of all groups are taken from the ancient languages Latin and Greek. Sometimes actually the names are derived from modern languages or from arbitrary combinations of letters, but then they are treated as if they were Latin, although they may amount to little more than "pig latin." Latin terminations are used as far as possible for new names.

Scientific names are made up of generic and specific designations, much as personal names consist of surnames and given names, but here the surname comes first, as, for example, *Prunus subcordata*. The genus *Prunus* includes all of the pitted fruits (prunes, plums, cherries, apricots, peaches, almonds), and the species *subcordata* is a particular type, the Sierra plum native in California.

Names of Genera

Generic names are commonly Latin or Greek nouns, although they "may be taken from any source whatever." According to recommenda-

tion X, "Botanists who are forming generic names show taste and judgment by attending to the following recommendations:—

"(a) Not to make names very long or difficult to pronounce, [however relatively few possible combinations of less than ten letters are still available].

"(b) Not to dedicate genera to persons quite unconnected with botany or at least with natural science nor to persons quite unknown [and not to dedicate lower groups such as species to persons who had nothing to do with their discovery or characterization].

"(c) Not to take names from barbarous languages, unless those names are frequently cited in books of travel, and have an agreeable form that is readily adaptable to the Latin tongue and to the tongues of civilised countries."

"(d) Not to make names by combining words from different languages (*nomina hybrida*)".

According to recommendation XXXIX, "When a new name for a genus . . . is taken from the name of a person, it should be formed in the following manner.

"(a) When the name of the person ends in a vowel the letter *a* is added (thus *Bouteloua* after Boutelou; *Ottoa* after Otto; *Sloanea* after Sloane), except when the name already ends in *a*, when *ea* is added (e.g. *Collaea* after Colla).

"(b) When the name of the person ends in a consonant, the letters *ia* are added (e.g. *Magnusia* after Magnus, *Ramondia* after Ramond), except when the name ends in *er*, when *a* is added e.g. *Kerneria* after Kerner) . . ."

Names of Species

The "names of species are binary combinations consisting of the name of the genus followed by a single specific epithet," which may be an adjective or a substantive. The epithet must be either a single word or a compound joined by hyphens, as, for example, *Adiantum Capillus-Veneris*, the maiden hair fern.

"The specific epithet, when adjectival in form and not used as a substantive, agrees in gender with the generic name." Most frequently the feminine ending is *-a*, the masculine *-us*, and the neuter *-um*, but this is by no means always the case. Examples: *Mentzelia reflexa*, *Linanthus dichotomus*, *Geranium incisum*. Trees are feminine, e.g. *Quercus agrifolia*. The following are recommendations for formation of specific names:

"XL. When a new specific or other epithet is taken from the name of a man, it should be formed in the following manner.

(a) When the name of the person ends in a vowel, the letter *i* is added (thus *Glazioni* from Glaziou, *Bureaui* from Bureau), except when

the name ends in an *a*, when *e* is added (thus *Balansae* from Balansa).

"(b) When the name ends in a consonant, the letters *ii* are added thus *Magnusii* from Magnus, *Ramondii* from Ramond), except when the name ends in *-er*, when *i* is added (thus *Kernerii* from Kerner) . . .

"(d) When epithets taken from the name of a person have an adjectival form they are formed in a similar way (e.g. *Geranium Robertianum*, *Verbena Hasslerana*).

"XLI. The same provisions apply to epithets formed from the names of women. When these have a substantival form they are given a feminine termination (e.g. *Cypripedium Hookerae*, *Rosa Beatricis*, *Scabiosa Olga*, *Omphalodes Luciliae*)."

It is recommended that specific names formed from personal names or the names of genera have the initial letter capitalized (e.g. *Disporum Hookeri*; *Ranunculus Populago*) and that others begin with a small letter (e.g. *Disporum trachyandrum*; *Ranunculus arizonicus*). Some botanists prefer to capitalize the initials of no specific names at all, and the rules do not specifically forbid this practice.

Names of Varieties

Species either are not further subdivided if they include no significant partly segregated populations or they may consist of a typical variety and one or more other varieties. The typical variety may or may not have a formal name other than that for the species as a whole, depending upon individual practice. Some designate it as variety *typica*, *genuina*, or *originaria*. The other varieties are given names similar to specific epithets, and, when they are in adjectival form, they agree in gender with the generic name.

A category of higher rank than variety is subspecies, and lower ones are subvariety, forma, and subforma. Many Old World and some New World botanists feel capable of distinguishing some or all of these ranks. This leads to such names as *Saxifraga aizoon* var. *typica* subvar. *brevifolia* forma *multicaulis* subforma *sarculosa* with an author's name or two inserted after each plant epithet in the chain although it is possible to omit all the subspecific names but the last. However, it is common practice to use only a single subspecific category, usually variety, or with some individuals subspecies. Definitions of the two categories vary greatly, and frequently what a particular person calls one is exactly what another botanist calls the other. Variety is the classical category below the rank of species, and it requires less formal changing of names than subspecies in all but the few groups

studied intensively by recent authors favoring subspecies over variety. For example, among the seventy-nine species of North American *Ranunculi* north of Mexico (Benson, 1940b, 1941-2, 1942) there are, in addition to the numerous typical varieties, sixty-three populations of lower rank than species. Only one has been named as a subspecies while all have been named as varieties. On the other hand, there is some danger of confusion of botanical varieties with horticultural varieties which are mere minor variants of commercial or aesthetic significance. Strictly speaking, however, the botanical term is *varietas*, and with this there should be no confusion. The question is far too complicated for a complete discussion here, and within the past few years taxonomists have argued it freely (cf. J. Clausen et al 1939, 1940; R. Clausen, 1941; Fernald, 1936, 1940; Fosberg, 1942; Hall, 1926; Weatherby, 1942.) To some, subspecies appears to be a shiny new idea represented by much needed new term. To others, subspecies seems to be a shiny new term for an old idea. Probably the truth is somewhere between these points of view.

If variety is adopted as the only recognized category below the rank of species the full name of a plant may appear as follows: *Meconella oregana* Nutt. var. *californica* Jepson. If subspecies is adopted, a name may appear as follows: *Orthocarpus faucibarbatu* A. Gray subsp. *albidus* Keck.

Names of Large Groups

The relative order of categories is as outlined below, and although "the definition of each of these categories varies, up to a certain point, according to individual opinion and the state of science . . . their relative order, sanctioned by custom, must not be altered": "Regnum vegetabile. Divisio. Subdivisio. Classis. Subclassis. Ordo. Subordo. Familia. Subfamilia. Tribus. Subtribus. Genus. Subgenus. Sectio. Subsectio. Species. Subspecies. Varietas. Subvarietas. Forma." This list may be augmented by supplementary categories, provided this does not introduce confusion or error. To the writer it seems ample. The commonly recognized categories are the following, again proceeding from largest to smallest: division, class, order, family, genus, species, variety (or subspecies).

"Names of families are taken from the name of one of their present or former genera and end in -aceae." Examples: *Rosaceae* (from *Rosa*), *Salicaceae* (from *Salix*), *Caryophyllaceae* (from *Caryophyllus*, a pre-Linnaean genus)."

"The following names sanctioned by long usage, are treated as exceptions to the rule: *Palmae*, *Gramineae*, *Cruciferae*, *Leguminosae*, *Gutti-*

ferae, *Umbelliferae*, *Labiatae*, *Compositae*. Botanists are authorized, however, to use as alternatives the appropriate names ending in -aceae. . . . Those who regard the *Papilionaceae* as constituting an independent family [from the pea family known in the broader sense as *Leguminosae*] may use that name, although it is not formed in the prescribed manner.

For groups of higher rank than family there are no rules and only broad recommendations. It is recommended that orders have names ending in -ales, but other terminations may be used, provided they do not result in "confusion or error." Examples: *Rosales* from *Rosaceae*; *Sapindales* from *Sapindaceae*; *Microspermae*; *Contortae*.

Priority of Names

Not all plant groups have the same starting point for priority of names. It is natural that the flowering plants and ferns should have been studied first, since they are largely conspicuous and since some are useful. The starting point for these and for most other plants is the first edition of Linnaeus' *Species Plantarum* (1753), and it is agreed that the generic names appearing in this book shall be associated with the descriptions published by Linnaeus in the fifth and sixth editions of *Genera Plantarum* (1754, 1764). For the fungi, which were little known to Linnaeus, the starting points are with later authors. Priority for names of fossil plants begins with the year 1820.

The rule of priority holds in all cases except for certain generic names which are conserved in spite of the rule (*nomina conservanda*). These are listed in supplements and in a subsequent publication (anonymous, 1940). It is obvious that occasionally names proposed in obscure or non-botanical publications will be overlooked and therefore not find their proper places in the botanical indices (Hooker & Jackson, 1885; Gray Herbarium, 1885-). Occasionally, when these names come to light, they are found to have priority over well-known names, despite not having been used by anyone. Adoption of them may require recombining names for all of the subordinate groups. For example, under the American Code of Botanical Nomenclature (anonymous, 1907), where strict priority was followed, it was necessary to substitute the name *Larrea* for *Hoffmanseggia*, a genus of the pea family, and to replace *Larrea* with *Covillea* for the creosote bush and its relatives. This involved numerous recombinations of names and no end of confusion. *Nomina conservanda* have been set up to avoid such occurrences.

The lists of *nomina conservanda* have not been applied to groups of other ranks than

genera. In a few cases it may be desirable to conserve the names of species, provided it is possible to draw the line between cases sufficiently important to receive such treatment and those barely not so significant. An example is the giant sequoia or big tree of California, long known as *Sequoia gigantea*, a name clearly invalid since it was used first for the coast redwood, a tree with a still earlier name, *Sequoia sempervirens*. The name *Sequoia gigantea* has been known for many years to the entire educated population of the earth, and only a few of the strictest adherents of absolute priority have considered upsetting it to be wise. However, the rules include no provision for its retention.

Effective Publication of Names

When new names are necessary or when names are recombined in harmony with reclassification of populations, certain rules of publication are required to establish their valid status. "Publication is effected . . . by sale to the general public or to botanical institutions, of printed matter or indelible autographs, or by distribution of these to specified representative botanical institutions," although, unfortunately, the list of botanical institutions has not been published. "No other kind of publication is accepted as effective: communication of new names at a public meeting, or the placing of names in collections or gardens open to the public . . ." is not effective.

"A name of a taxonomic group is not validly published unless it is . . . accompanied by a description of the group or by a reference to a previously and effectively published description of it," . . . and since January 1, 1935, "the names of recent plants, the Bacteria excepted, are considered validly published only when they are accompanied by a Latin diagnosis." Names published between 1908 and 1934 with diagnoses in modern languages are accepted, however, and this makes legitimate much of the work done under the American Code (anonymous, 1907), which did not require Latin descriptions.

Requirement of a Latin diagnosis serves a two-fold purpose. First, Latin is a language known among scholars throughout the earth, and many modern languages are known to only a few. Substitution of a choice among specified "leading" modern languages raises the question of which ones enjoy this distinction. Second, casual or accidental publication of names in obscure non-botanical journals and in periodicals not intended to be of a permanent nature, such as newspapers and trade catalogs, are practically always invalidated by lack of Latin diag-

noses. Occasionally, names published long ago in obscure or ephemeral publications are brought to light, and frequently these have priority over well established names published as the result of careful research. As an example of newspaper publication, the plants of a little known grove of California fan palms native in a desert mountain range received a formal and valid name as a species because they were discussed and described in a local newspaper. The intention of a specialist in palms to apply the name was stated, but the purpose announced for him has not been followed up in almost twenty years. Had a Latin description been required in 1923, the superfluous name could have been ignored, unless the author, still believing the palm to be a distinct species, chose to describe it in Latin.

Modification, Division, and Union of Groups

A taxonomist, upon completing the organization of a group of plants, may find that his treatment differs from previously published ones. The fact that he has altered a group, expanded its scope, or circumscribed it, "does not warrant a change in its name, except in so far as this may be necessitated (1) by transference of the group," as, for example, a species to another genus, "(2) by its union with a group of the same rank . . . , or (3) by a change in rank. . . ."

"When a genus is divided into two or more genera, the generic name must be retained for one of them, . . ." and "when a species [or group of lower rank] is divided into two or more species [or other groups], the specific [or other] epithet must be retained for one of them." Determination of the group to bear the original name is dependent upon the type method, described below:

Each species or variety is based upon a type specimen designated by the author at the time of publication of the name, and each genus is based upon a type species. The type plant is the one with which the name is associated permanently, and it affords a means of determining exactly what plant the author was naming. Unfortunately, the type method is a recent development (the great contribution of the American Code), and types were not designated in the earlier literature. However, in most cases a particular specimen (to be considered as the type) or a group of specimens (each a cotype) was cited. Sometimes only the general range of the plant was given, and application of the name may depend upon finding plants which fit the description or which may be associated with the name for other reasons. In some cases, the application of the name may remain dubious.

The population retaining the original name is

the one to which the type specimen belongs. For the other segregated populations other names must be chosen if they exist, or otherwise new names must be applied. If a valid name previously has been based upon any plant falling within one of these populations, then that name, converted if necessary into the proper form, must be used. If more than one has been applied, a choice must be made according to the rule of priority.

The following is an example of invalid alteration of the name of a previously and validly described species. In 1930 an author concluded that a particular species occurring in Oregon had been described originally from abnormal specimens, differing slightly from any of the population he had found in the field. The plant was given a name as a new species with the remark, "Since Greene's plant [the type upon which the original name was based] is here regarded as merely an abnormal form of this proposed new species we would include it as a synonym." Following such a policy as this to its logical conclusion would result in renaming thousands upon thousands of plants, for the original or type specimen is "not necessarily the most typical or representative element of a group; it is merely that element with which the name of the group is permanently associated." It is not uncommon for the type specimen to represent a minor phase of a species or variety, but, so long as it represents any element within the group, the name applied to it applies to the entire population. Had the author in question considered the plant described previously by Greene as a separate species, it would have been legitimate to propose a new species with a new name to encompass the population with which he was familiar, but to apply a new name to cover the same species in its expanded scope was not legitimate.

Application of the rules above to modification, division, and union of groups gives rise to various nomenclatorial complications, and these are discussed in the following paragraphs.

"When a species is transferred to another genus (or placed under another generic name for the same genus), without change of rank, the specific epithet must be retained, . . ." unless the following obstacle exists: that the resulting binary combination of names is a later homonym (a duplicate of a name previously used for another plant) or a tautonym (the generic and specific names being exact duplicates). Examples: Under *Linaria*, *Antirrhinum spurium* L. becomes *Linaria spuria* (L.) Mill.; *Spartium biflorum* Desf. does not become *Cytisus biflorus* because that name was applied to a different species of *Cytisus* at an earlier date,

and consequently it is known by the next legitimate name in order of priority, *Cytisus Fontanesii* Spach.; *Spiraea Aruncus* when it is considered to form the type of a segregate genus, *Aruncus*, can not be called *Aruncus Aruncus* (L.) Karst., and it must receive a later name, e.g. *Aruncus sylvester* Kostel.

"When a variety or other subdivision of a species is transferred, without change of rank, to another genus or species (or placed under another generic or specific name for the same genus or species), the original subdivisional epithet must be retained . . . unless the resulting ternary combination has been previously and validly published for a subdivision based on a different type. . . ." Examples: *Helianthemum italicum* Pers. var. *micranthum* Gren. & Godr. after transfer to another species may become *Helianthemum penicillatum* Thib. var. *micranthum* (Gren. & Godr.) Grosser; *Parosela Schottii* (Torr.) Heller var. *puberula* Parish under the generic name *Dalea* becomes *Dalea Schottii* Torr. var. *puberula* (Parish) Munz.

"When the epithet . . . on transference . . . has been applied erroneously in its new position to a different plant, the new combination must be retained for the plant on which the group was originally based." In other words, every name is permanently associated with the type specimen or with its original application to a particular population, and no amount of misuse can change this. For an example of misapplication of a name, *Cercidium floridum* Benth. ex A. Gray was described in 1852 and Gray, who supplied the description, interpreted the species as including primarily specimens of a palo verde growing in Texas and northeastern Mexico, although two Gila River plants are cited. The type specimen, named by Benthham and deposited at the Herbarium of Trinity College, Dublin, Ireland, and not inspected by American authors, proves to be a collection of the palo verde of California, Arizona, and northwestern Mexico collected at Hermosillo, Sonora. Consequently, with this point established, *Cercidium floridum* replaces the later name *Cercidium Torreyanum* for the western plant, and the Gulf Coast tree becomes known by a new name, *Cercidium macrum* I. M. Johnston (cf. Benson, 1940a).

"When two or more groups of the same rank are united the oldest legitimate name or (in species and their subdivisions) the oldest legitimate epithet) is retained. If the names or epithets are of the same date, the author who unites the groups has the right of choosing one of them. The author who first adopts one of them, definitely treating another as a synonym or referring it to a subordinate group, must be fol-

lowed." "Examples: K. Schumann . . . , uniting the three genera *Sloanea* L. (1753), *Echinocarpus* Blume (1825), and *Phoenicosperma* Miq. (1865-1866) rightly adopted the oldest of these three generic names, *Sloanea* L., for the resulting genus." Union of *Dentaria* and *Cardamine*, published simultaneously by Linnaeus, must result in a genus called *Cardamine*, "because this name was chosen by Crantz . . . who was the first to unite them." The names *Acacia cuspidata* Schlect. (1838) and *Acacia texensis* Torr. & Gray (1840) were applied to members of the same population. If the group is to be treated as a species, its name is *Acacia cuspidata*. "Robert Brown . . . appears to have been the first to unite *Waltheria americana* L. . . . and *W. indica* L. . . . [published simultaneously]. Since he adopted the name *Waltheria indica* and stated that he considered *W. americana* to be a variety of it, the name *W. indica* must be retained for the combined species."

"When a tribe becomes a family, when a subgenus becomes a genus, when a subdivision of a species becomes a species, or when the reverse of these changes takes place, and in general when a group changes its rank, the earliest legitimate name or epithet given to the group in its new rank is valid, unless that name or the resulting association or combination is a later homonym . . . , that is, identical with a name used previously for another plant. Example: *Magnolia virginiana* L. var. *foetida* (L. (1753) must be called *Magnolia grandiflora* L. (1759), instead of *Magnolia foetida* (L.) Sarg. (1889), since *grandiflora* has priority in specific rank. However, if the group were transferred as a variety to another species, it would be var. *foetida*, since this epithet has priority in varietal rank.

Citation of Authors' Names

It will be noted that in the examples in the preceding paragraphs, sometimes the name of a single author follows the name of a plant. This constitutes a reference to the original place of publication, and it offers a means of determining what specimen is the type. In other cases, when two personal names follow the plant name, the first (in parenthesis) refers to the original publication, and the one following to the publication of the particular combination of names. For example, a plant in the pea family was named originally *Hosackia strigosa* Nutt., and its identity was established in Nuttall's original publication. Later, *Hosackia* was referred by Greene to *Lotus*, and the name became *Lotus strigosus* (Nutt.) Greene.

"When a name of a taxonomic group has been proposed but not published by one author, and is subsequently validly published and ascribed to him (or her) by another author who

supplied the description, the name of the latter author must be appended to the citation with the connecting word *ex*." For example, *Cercidium floridum* was described by Asa Gray and ascribed to Bentham. It is written as *Cercidium floridum* Benth. ex A. Gray, since the original publication was in a book of which Gray was the author. Had Bentham supplied the description as well as the name, the connecting word should be *in* instead of *ex*. Had the combination with a description by Bentham been published in a technical journal, where Gray's name did not appear as a part of the title of the publication, the connecting word should have been *apud* instead of *in*.

Rejection of Names

"A name or epithet must not be rejected, changed or modified, merely because it is badly chosen, or disagreeable, or because another is preferable or better known." It is obvious that to throw the names of plant into disputes over which had the pleasanter sound would result in chaos, even in a single country, let alone in the world as a whole.

"A name is to be rejected in the following cases:

"(1) If it was superfluous when published, i.e. if there was a valid name . . . for the group to which it was applied, with its particular circumscription, position or rank . . ." For example, *Ranunculus terrestris* Wynd is a superfluous name for *Ranunculus Gormanii* Greene, since admittedly it was applied to the same species.

"(2) If . . . its author did not adopt the earliest legitimate epithet for the group with its particular circumscription, position or rank. . . .

"(3) If it is a later homonym, . . ." that is, identical with a properly published name previously used for another group.

(4) " . . . If owing to its use with different meanings, it becomes a permanent source of confusion or error. A list of names to be abandoned for this reason (*Nomina ambigua*) will form Appendix IV," not yet published.

(5) " . . . When its application is uncertain (*nomen dubium*)."

(6) " . . . If the characters of that group were derived from two or more entirely discordant elements, especially if those elements were erroneously supposed to form a part of the same individual. A list of names to be abandoned for this reason (*Nomina confusa*) will form Appendix V," not yet published. As an example, John C. Fremont accidentally mixed specimens of the coiled pods of the screw bean, *Prosopis pubescens* with leaves and flowers of the western honey mesquite, *Prosopis juliflora*

var. *Torreyana*. When John Torrey based a described species, *Prosopis odorata*, upon this material, he did not realize, as he stated later, that parts of two species were involved. Subsequent authors have attempted to establish the name of *Prosopis odorata* for the screw bean and for the velvet mesquite, *Prosopis juliflora* var. *velutina* (cf. Benson, 1941, p. 753-4), and the name has become a permanent source of confusion.

(7) . . . "When it is based on a monstrosity."
" . . . A name or epithet to be rejected is replaced by the oldest legitimate name, or (in a combination) by the oldest legitimate epithet which will be, in the new position, in accordance with the Rules. If none exists, a new name or epithet must be chosen." However, an old

and well-known illegitimate name may be preserved sometimes by validly publishing it in a new position where there is no obstacle to its use. For example under a different genus the well-known illegitimate name may be used as a new name.

IV. DESCRIPTION

When plants have been classified and named, it is still necessary to provide means for others to identify them. This is accomplished through keys and descriptions.

Keys

The following is an example of the key to a small group of species of the genus *Acacia* occurring in the deserts of the Southwestern United States:

KEY TO THE SPECIES

1. Flowers in cylindrical spikes or in heads with a tendency to be racemose; filaments of the stamens white or tinged with pink or lavender or else creamy-yellow, not a bright nearly golden yellow; stems not with a pair of stout, rigid spines at each node, either with a pair of weak, more or less flexible spines at each node or with prickles irregularly disposed on the stem or unarmed; petals separate:
 2. Inflorescence composed of cylindrical spikes 2-4 cm. long and 10-12 mm. in diameter; stems with a pair of weak spines at each node or with prickles disposed irregularly; pods 9-19 mm. broad; seeds broader than long:
 3. Prickles disposed irregularly on the stem, similar to rose-prickles or to a cat's claws, broad at the bases and curved above, about 3-5 mm. long; spines none; flowers creamy yellow; pods mostly 6-13 cm. long, 10-19 mm. broad, often constricted between the seeds; primary leaflets in 2-3 pairs; secondary leaflets in 4-6 pairs, each leaflet oblong obovate, 3.5-7 mm. long 1-3.5 mm. broad. 1. *Acacia Greggii*
 3. Prickles none, the stipules forming two slender, weak spines at each node of the stem; flowers white; pods 5-8.5 cm. long, 9-12 mm. broad, not constricted between the seeds; primary leaflets in usually 5-10 pairs; secondary leaflets in about 20-30 pairs, each oblong but with an acute tip, about 2-3 mm. long, approximately 1 mm. broad. 2. *Acacia millefolia*
 2. Inflorescence composed of heads with a tendency to be racemose; stems with neither spines nor prickles; pods 7-9 or 10 mm. broad, not constricted between the seeds; seeds markedly longer than broad. 3. *Acacia angustissima*
1. Flowers in nearly hemispherical heads; filaments of the stamens a bright nearly golden yellow; stems with a pair of stout rigid spines at each node; petals united; seeds longer than broad:
 2. Pod flattened, constricted between the seeds, not woody, splitting promptly, the seeds in one row; common. 4. *Acacia constricta*
 2. Pod nearly cylindrical, not constricted, woody, splitting tardily, the seeds in 2 rows; rare in California and Arizona. 5. *Acacia Farnesiana*

Keys are essentially outlines adapted for use in determining the identity of particular plants. To identify a Southwestern desert plant species known (as the result of using other keys) to belong to the genus *Acacia*, it is necessary first to determine by a study of the characters whether it "fits" the upper or lower of the two leads of the key numbered "1." If the plant fits the upper lead with this number, it is one of three species, *Acacia Greggii*, *Acacia millefolia*, or *Acacia angustissima*. If it fits the second, it is either *Acacia constricta* or *Acacia Farnesiana*. Should it fit the upper lead, the next step is a choice between the two subordinate leads numbered "2." If it fits the lower, the plant is *Acacia angustissima*, but if it fits the upper, it is

necessary to choose between the two leads numbered "3" in order to determine whether it is *Acacia Greggii* or *Acacia millefolia*.

In writing keys, the taxonomist pays attention to a number of points of technique. Particular characters are not available at all seasons of the year or in all pressed specimens, and therefore it is important to include all of the stable characters. It is true that this makes the keys longer and sometimes slightly cumbersome, but if some stable characters are omitted, too often the characters retained (usually the "obvious" ones) break down and the key becomes impossible to follow. This is nearly always the case with "simplified" keys and with those based upon predetermined or "artificial"

characters, as for example, leaf-types, and ignoring the other parts of the plants. It is important to include measurements rather than to use comparative terms such as "long" vs. "short," "narrow" vs. "broad," or, as was used in one case "tall" vs. "taller." Opposing of more than two lines is to be avoided, because often the third line is overlooked and because it is simpler to distinguish between two lines than to hunt among several. Use of more than two lines commonly reflects inadequate organization of characters, although this is not necessarily the case. It is always good practice, even when the lines are numbered as they are in the sample above, to begin each of the two opposed lines with the same word, as for example: flowers vs. flowers, inflorescence vs. inflorescence, prickles vs. prickles, pod vs. pod.

Descriptions

It is of first importance that descriptions be adequate, that is, that they cover all of the significant characters, but it is important too, that the characters be selected. Descriptions may be criticized for any of several faults. Some are inaccurate and carelessly compiled; others are accurate but the characters are not well-selected to set the group off from its immediate relatives; others are painstakingly accurate down to the last fly speck on the stem, but so detailed that the reader is left with the task of determining what is significant and what is not, a problem for which he is ill-equipped with perhaps only a single specimen before him. There are numerous definitions of intelligence, and probably no definition is adequate, but a thought-provoking one is the following, "Intelligence is the ability to recognize the significant elements in a situation." Recognition of the significant elements or significant characters to be described is surely the test of a plant description and indirectly of its author.

Casual inspection of most manuals reveals striking inconsistency in the way the species of each genus, the varieties of each species, or the genera of each family are described. Often it is impossible to determine whether the characters described for one species exist at all in its closest relative, and the author seems to have described the characters of each species just as they came to his mind. He may describe the stems of one and omit them entirely in the next; he may give

the leaf shape for one and not mention its margin and do the reverse for its nearest relative. Obviously a standard practice should be formulated to cover the variable characters of the members of each group. Characters which do not vary should be described for the group as a whole but not for its individual elements. For example, it would be folly to include the words "stamens 6" under each genus and species of the lily family, for this is practically a family character.

To distinguish the Southwestern *Acacias* from one another, a form similar to the following may be set up:

1. ACACIA GREGGII A. Gray. CAT CLAW.

Large shrubs or small trees up to 7 m. high; prickles dark brown or gray, broad-based, curved, 3-5 mm. long; primary leaflets in 2-3 pairs; secondary leaflets in 4-6 pairs, cuneate-oblong, 4-7 mm. long, 1.5-3 mm. broad, not hairy; stipules thin, scale-like, falling away while the leaf is young; flowers pale yellow, in dense, cylindrical spikes 3-5 cm. long and about 1 cm. in diameter; calyx green, 2 mm. long; petals green with narrow, creamy margins, separate, 3 mm. long; stamens about 50, the filaments pale yellow, about 6 mm. long; pods ribbonlike, somewhat twisted, often constricted between the seeds, usually 6-13 cm. long, about 1.2-1.4 cm. broad; seeds dark, biconvex, nearly circular but slightly broader than long, about 7-8 mm. long, 8-10 mm. broad.

The sequence of characters is the customary one, beginning with vegetative parts of the plant and proceeding to flowers and then fruits.

When new species or other groups are described, commonly the name appears in bold-face type to facilitate indexing. In addition to the ordinary modern language diagnosis, a Latin diagnosis is required, as stated in the previous section, and the type specimen should be designated. Also the relationships of the new entity and its distinctions from its near relatives should be set forth, and enough herbarium specimens should be cited to enable others in various parts of the country or if possible the world to have a means of checking upon the identity of the newly-discovered plant.

In all cases, it is important to describe the range and ecological requirements of each group and to determine and state its association with other species as it occurs in nature.

The writer wishes to express appreciation to Mr. C. A. Weatherby of the Gray Herbarium, Harvard University, for checking the manuscript and for his helpful suggestions.

DEPARTMENT OF BOTANY

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LITERATURE CITED

- ANONYMOUS. 1867. Laws of botanical nomenclature adopted by the International Botanical Congress held at Paris in August, 1867.
- ANONYMOUS. 1907. American code of botanical nomenclature. BULLETIN OF THE TORREY BOTANICAL CLUB 34: 167-178.
- ANONYMOUS. 1940. Additional nomina generica conservanda (Pteridophyta and Phanerogamae). BULLETIN OF MISCELLANEOUS INFORMATION. Royal Botanic Gardens, Kew, England. (3): 81-134.
- AXELROD, DANIEL I. 1940. Late Tertiary floras of the Great Basin and border areas. BULLETIN OF THE TORREY BOTANICAL CLUB 67: 477-488.
- BENSON, LYMAN. 1940a. Taxonomic contributions. AMERICAN JOURNAL OF BOTANY 27: 186-190.
- . 1940b. The North American subdivisions of *Ranunculus*. AMERICAN JOURNAL OF BOTANY 27: 799-807.
- . 1941. The mesquites and screw-beans of the United States. AMERICAN JOURNAL OF BOTANY 28: 748-754.
- . 1941-2. North American *Ranunculi* I-V. BULLETIN OF THE TORREY BOTANICAL CLUB 68: 157-172, 477-490, 640-659, 69: 298-316, 373-386.
- . 1942. The relationship of *Ranunculus* to the North American floras. AMERICAN JOURNAL OF BOTANY 29: 491-500.
- BRIQUET, JOHN. 1935. International rules of botanical nomenclature. Gustav Fischer, Jena. See also RENDLE.
- CHANEY, RALPH W. 1925. A comparative study of the Bridge Creek flora and the modern redwood forest. CARNEGIE INSTITUTION OF PUBLICATION (349): 1-22.
- . 1938. Paleocological interpretations of Cenozoic plants in Western North America. BOTANICAL REVIEW 4: 371-396.
- CLAUSEN, JENS, DAVID D. KECK, AND WILLIAM H. HEISEY. 1939. The concept of species based on experiment. AMERICAN JOURNAL OF BOTANY 26: 103-106.
- . 1940. Experimental studies on the nature of species. I. Effect of varied environments on western North American plants. CARNEGIE INSTITUTION OF WASHINGTON PUBLICATION (520): 1-452.
- CLAUSEN, ROBERT T. 1941. On the use of the terms "subspecies" and "variety." RHODORA 43: 157-167.
- FERNALD, M. L. 1936. Minor forms and transfers. RHODORA 38: 233-236.
- . 1940. Some spermatophytes of eastern North America. RHODORA 42: 229-276.
- FOSBERG, F. RAYMOND. 1942. Subspecies and variety. RHODORA 44: 153-157.
- GRAY HERBARIUM. 1885-. GRAY HERBARIUM CARD INDEX, being a catalogue of American plants published since 1885. (Includes new groups of all ranks for the Western Hemisphere.)
- HALL, H. M. 1926. The taxonomic treatment of units smaller than species. PROCEEDINGS OF THE INTERNATIONAL CONGRESS OF PLANT SCIENCES. Ithaca. 2: 1461-1468.
- HOOKE, JOSEPH D. AND B. DAYDON JACKSON. 1885-. INDEX KEWENSIS, an enumeration of the genera and species of flowering plants. London. (Supplements at mostly five-year intervals since 1885. Groups of lower rank than species not indexed.)
- LINNAEUS, C. 1753. SPECIES PLANTARUM. Ed. 1.
- . 1754, 1764. GENERA PLANTARUM. Eds. 5, 6.
- RENDLE, A. B. 1934. INTERNATIONAL RULES OF NOMENCLATURE ADOPTED BY THE FIFTH INTERNATIONAL BOTANICAL CONGRESS, Cambridge, 1930. Supplement to the Journal of Botany, British and Foreign. 72: 1-29. See also BRIQUET.
- SHARP, LESTER W. 1934. INTRODUCTION TO CYTOLOGY. McGraw-Hill, New York. (Citing on *Galeopsis*, Müntzing, A. Hereditas 14: 153-172. 1930, and on *Rosa*, Täckholm, G. Svensk Bot. Tidskr. 14: 300-311. 3 figs. 1920 and Acta Horti Bergiani 7: 97-381. 56 figs. 1922.)
- WEATHERBY, C. A. 1942. Subspecies. RHODORA 44: 157-167.

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Experimental Growing Contest

By SCOTT E. HASELTON

A year ago in July we distributed 20 experimental cacti: 5 *Echinopsis* hybrids, 5 *Notocactus submammulosus*, 5 *Mammillaria elongata*, 2 or 3 each *Hamatocactus setispinus* and *M. camptotricha*. We also enclosed an Epiphyllum cutting from the Wagener collection, a tiny tuber from the stem of *Ceropegia woodii* from the plant shown in Fig. 119 of "Succulents for the Amateur," a 2-inch cutting from *Euphorbia submammillaris* from the plant shown on page 586 of the "Succulent Euphorbieae," two fruits of *Opuntia elata*, and an offset of *Notocactus scopae* var. *ruberrima* from the plant pictured in the "Amateur Bulletin" pg. 107.

The purpose of the experiment was to grow these plants in various soils and exposures to find the best cultural methods for growth and flowers. The first prize (of glory only) was to be awarded to the grower who first succeeded in flowering the plants. All parts of the country were represented except the Pacific Coast but the Editor's control set made up for the lack of interest in that part of the U.S.A. where cacti are most easily grown.

The only flowers to date: Mrs. A. Voss of

Ohio reported that *Opuntia elata* fruits produced a flower in October, 1942, and three branches by October 19th. Then too, Winchell Rodgers of "Cereusly Speaking" had two *M. elongatas* flower in March. Of course your Editor had flowered these same plants long before due to outdoor growth in sunny California! And now the skillful Editor scoops again with proof of abundant flowers on the *Echinopsis* plants. And by the way, the same runner-up, J. E. C. R. in his column under March 17, quotes a quote from an unauthoritative source (!) as follows:

"March 17. Wish I had read that translation from the German from Monatschrift: 'South American Cacti' by Curt Knebel in the January, 1942, issue of 'D———', before I talked in Cleveland in February. The article is called 'Something About Echinopsis.' Knebel points out that those plants with excessive off-sets are usually shy bloomers."

Winchell should take a look at the *Echinopsis*, shown in the accompanying photo, loaded with offsets and every one budded or flowering (in May). The plant with the most offsets (20) has the most buds. Thus another theory is exploded. The three potted plants in 5-inch pots were 1½-inch *Echinopsis* "pups" of last July

(See photo on next page)

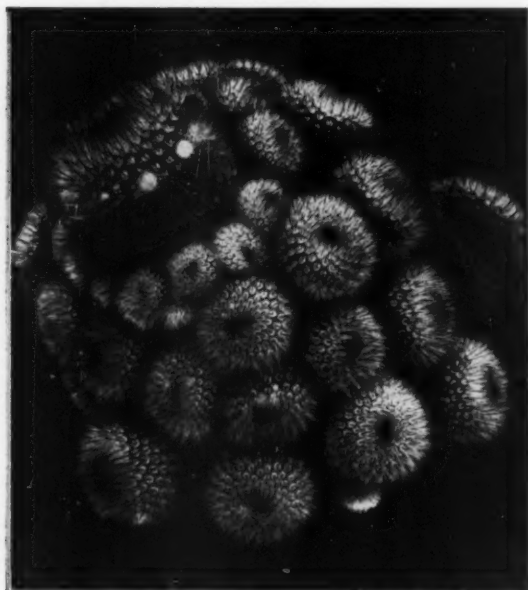


FIG. 45. LEFT: *Notocactus scopae* var. *ruberrima* from which "pups" or offsets were taken for the experiment. The plant pictured had about 50 offsets as a grafted plant 3 years old.

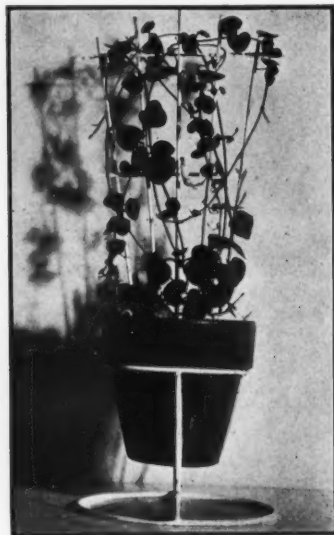


FIG. 46. RIGHT: The Rosary Vine (*Ceropegia woodii*) which is easily grown from the tubers that form along the stem.

FIG. 47. The top picture shows samples of the small plants used for the experiment. Left to right: *Epiphyllum hybrid*, *Mam. elongata*, *Notocactus submammulosus*, *Echinopsis hybrid*, *Hamatocactus setispinus*, *Mam. camptotricha*, *Opuntia elata*, *Euphorbia submammillaris*, and *Cereopogia woodii*.

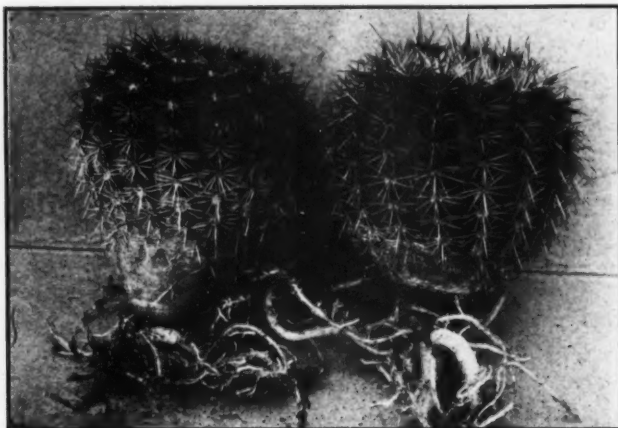


Lower picture. One year later: The *Epiphyllum* cutting doubled in size and budded but has yellow growth due to exposure and not rich enough soil. Between the first and second pots on the left is a rooted *Notocactus scopia* showing that they can be grown on their own roots. In front of the ruler are two *Opuntia elata* fruits each having developed several branches; last fall one of the fruits produced a flower while the other produced a branch—how do they know whether to grow branches or flowers? On the left of the *Opuntias* are 3 *Mammillaria camptotrichas* (note the difference in the denseness of the spines) the largest is 3 inches across with 20 or more offsets; no buds yet.

In front of the *M. camptotrichas* are three *Hamatocactus setispinus* which are making much slower growth than the others, however, they are taking on the characteristics of mature plants—the new spines are bright red while the older spines are almost white. The *Euphorbia submammillaris* has grown from a 1½-inch three-branched cutting to an attractive flowering 6-inch plant of 40 branches. The three *M. elongatas* have not made much growth but have flowered profusely with their inconspicuous whitish flowers. The front row of *Notocactus submammulosus* have grown to double the original size and by looking closely a bud can be seen on the second plant from the left. Extending over the ground in the whole lower left hand corner of the flat is the *Cereopogia woodii* with vines a foot or more long, flowering and forming new tubers along the stems; this was the only plant that was partly frosted at 30 degrees.

FIG. 48.

Notocactus submammulosus seedlings (natural size July, 1942). The seeds came from an imported plant from Uruguay.



which were planted in a rich mixture and were kept growing all winter in California out of doors. During the warmer days they were watered thoroughly and in the spring they were given monthly applications of liquid manure. They were exposed to full sun at all times. The lowest temperature subjected to these plants was 30 degrees.

Mam. elongata must present a problem to dealers who try to ship rooted plants with branches which break off at the slightest touch—

the only advantage is that you then have five plants instead of one! *Mam. camptotricha*, the so-called Birds Nest Cactus because of its mass of stiff hairs, is also a "soft plant" and is harder to ship than the more firm plants.

One of the small *Notocactus submammulosus*, one and one-half inches in diameter when we rooted it last fall, now has 10 offsets. On this "pup" we hollowed out the growing center as shown on page 109 of "Cacti for the Amateur." This was one of Dr. Poindexter's theories for

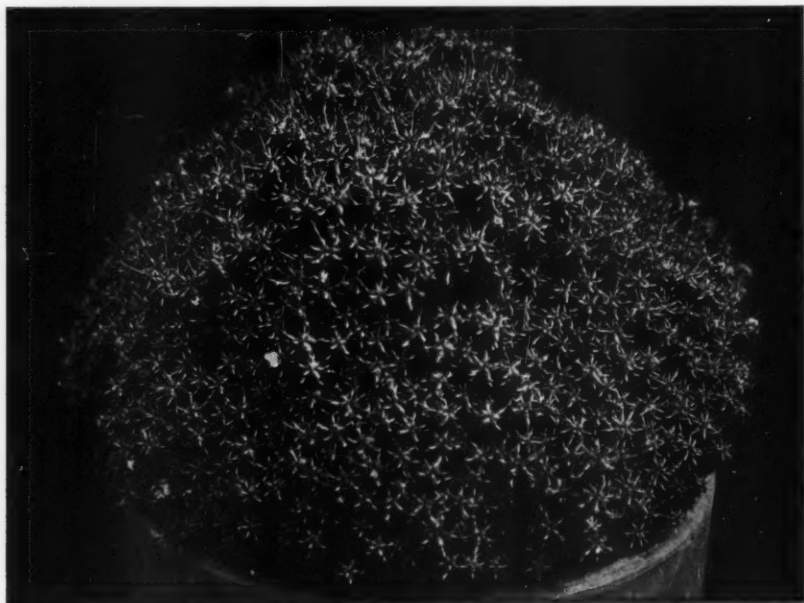


FIG. 49. *Euphorbia submammillaris* in the editor's collections from which the cuttings were taken. One could make a "million" plants from this old specimen within a year.



FIG. 52. Fruit of *O. elata* which has rooted and flowered. Following the flowers will be new branches (pads).

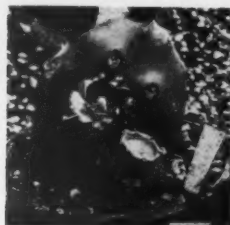


FIG. 50. LEFT: *Opuntia monacantha* (vulgaris) fruit producing a new branch and flower. (Courtesy of Howard Gates.) FIG. 51. CENTER: *O. elata* showing fruit which will root if picked green or before they become red, indicating ripening. The fruit is not proliferous, that is, producing growth on the fruit while attached to the parent plant. These photos show the difference between *O. monacantha* and *O. elata*.

forcing offsets and it works.

The first of June one of the Hamatocactus seedlings flowered and the others were loaded with buds.

This demonstration shows that small nursery grown plants can be grown into interesting and flowering specimens within the year. Of course, Kelly would say this was due to the excellence of his seedlings furnished for the experiment!

Last fall we had reports from the following: Mrs. Esther Williams, Ia.; Mr. and Mrs.

Wahrer, Ohio; Rufus Blair, Mass.; Mrs. L. G. Wilkinson, Ill.; Mrs. Chas. Pabst, N. Y.; Mrs. Henry Wurr, Ia.; Prof. Arthur Blocher, Ill.; Mrs. R. C. Avery, Ia.; Miss Eileen M. Curran, N. Y.; Sherman S. Shaffer, Texas; and others were less complete. We would now like your conclusions within the next 90 days in which you state the sizes of the plants, the number of flowers, the number of offsets, clay pots vs. glazed pots, rich soil vs. lean soil, and any general observations and summary.

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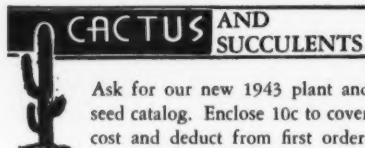
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